NeuroGuard

Cutting Edge Precision without Cutting Nerves

ECE 445 Senior Design Course Launch, 8/26/25

Our Team

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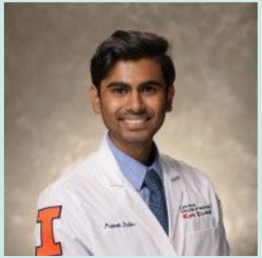

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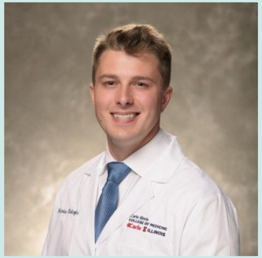

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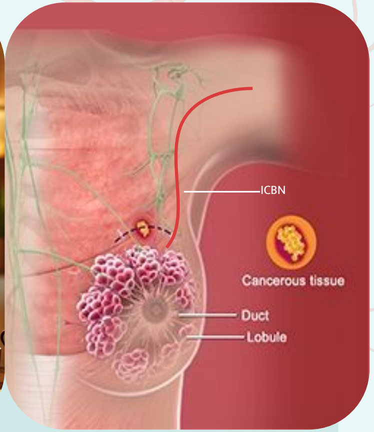


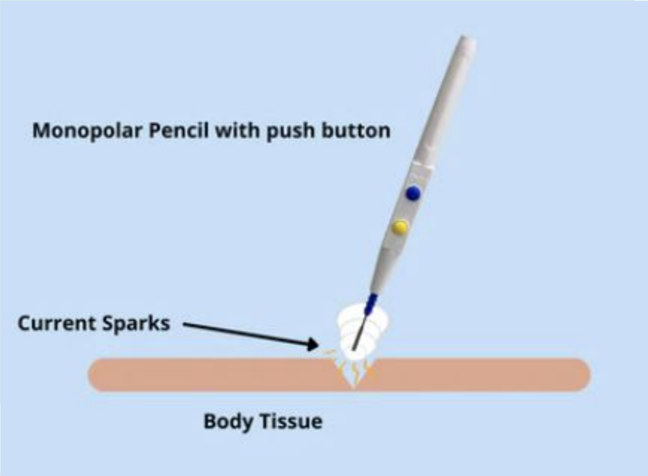
40-60%

Nerve Injury rate with mastectomy

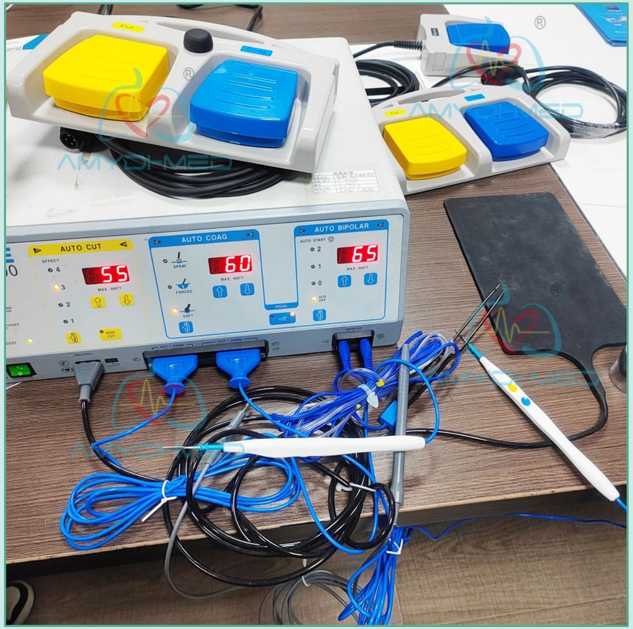
Over 100,000/year in US

Statistics from University of Michigan Health

An Electrical Engineering Problem, not a clinical one

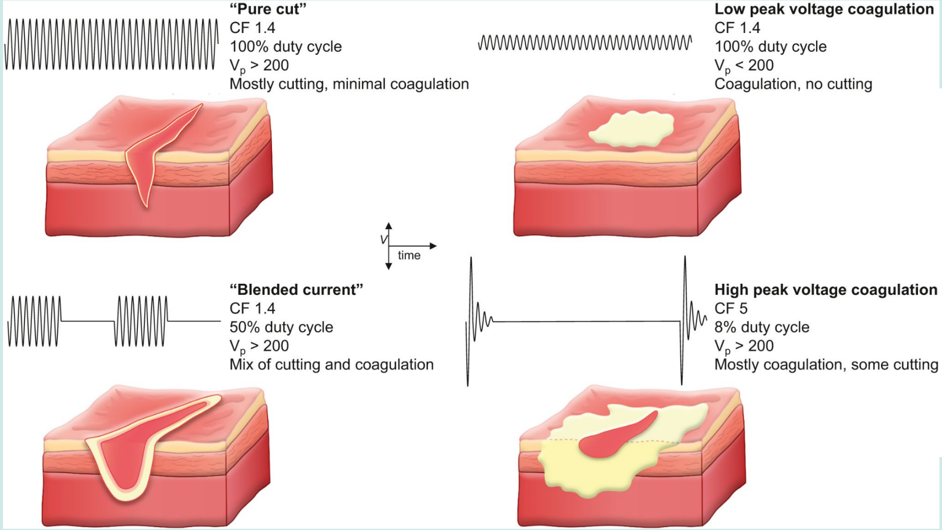


Electrocautery components



- Foot pedals
- Cautery unit
- Probe
- Grounding pad (monopolar)

Energy Delivery by Duty Cycle



OUTPUT CHARACTERISTICS

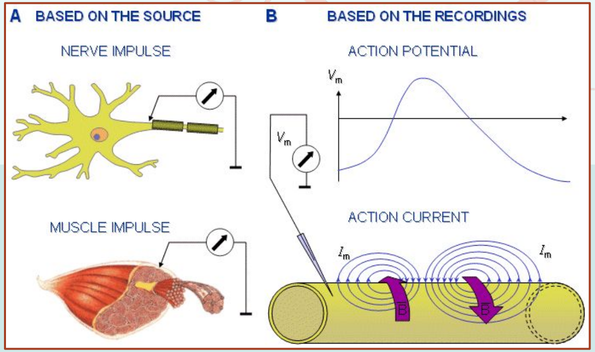
Maximum Output for Monopolar and Bipolar Modes

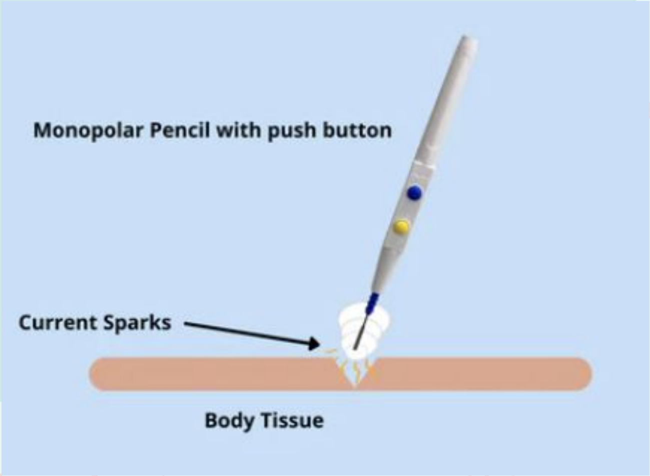
Power readouts agree with actual power into rated load to within 20% or 5 watts, whichever is greater.

Mode	Output Power	Output Frequency	Repetition Rate	Open Circuit Vpeak max	Crest Factor* (Rated Load)
Cut	120 W @ 500 Ω	357 kHz ± 50 kHz	N / A	1250V	2.9 ± 20%
Blend	90 W @ 800 Ω	357 kHz ± 50 kHz	30 kHz ± 5 kHz	1850V	3.3 ± 20%
Coagulation	80 W @ 1000 Ω	475 kHz ± 19 kHz	57 kHz ± 5 kHz	3300V	5.5 ± 20%
Fulguration	40 W @ 1000 Ω	410 kHz ± 50 kHz	25 kHz ± 5 kHz	3900V	7.7 ± 20%
Bipolar	30 W @ 200 Ω	520 kHz (-14 kHz, +29 kHz)	32 kHz ± 5 kHz	1200V	6.9 ± 20%

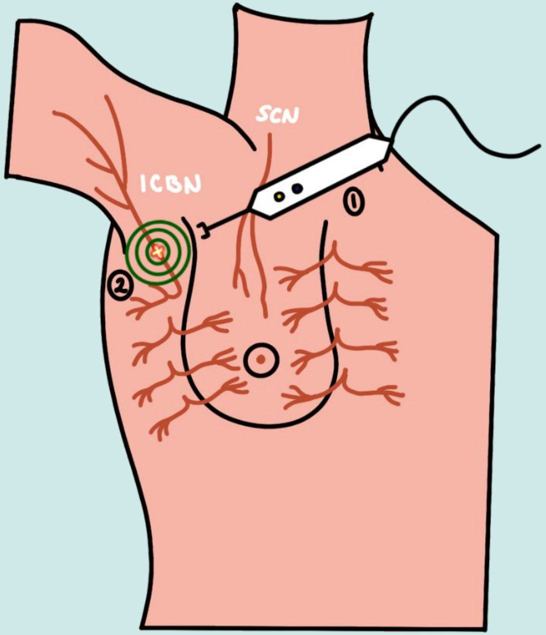
* an indication of a waveform's ability to coagulate bleeders without a cutting effect

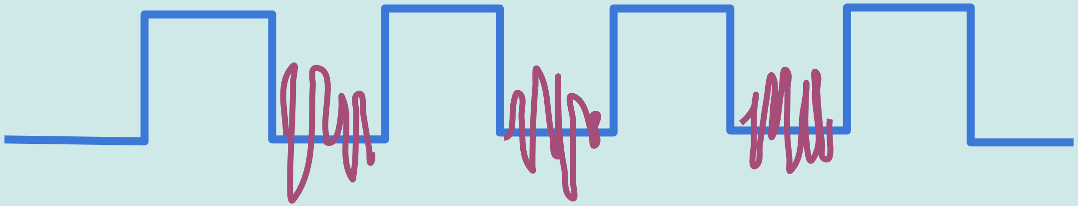
An Electrical Engineering Problem, not a clinical one





Neuroguard Components





Electrocautery waveform (~1000 V, 510 kHz)

Nerve stimulation waveform (~0.1 V, 100 Hz)

Modifying the Electrocautery Duty Cycle

IEEE TRANSACTIONS ON BIOMEDICAL ENGINEERING, VOL. 70, NO. 6, JUNE 2023 1729

Output Power Computation and Adaptation Strategy of an Electrosurgery Inverter for Reduced Collateral Tissue Damage

Congbo Bao, *Student Member, IEEE*, and Sudip K. Mazumder, *Fellow, IEEE*

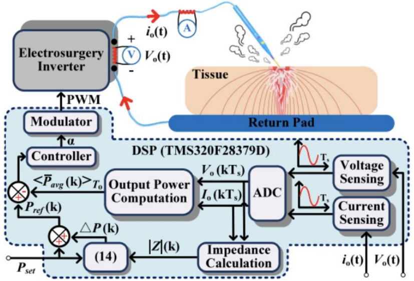


Fig. 7. Closed-loop control block diagram. The modulator outputs pulse-width modulation (PWM) signals that switch GaN devices in electrosurgery inverter.

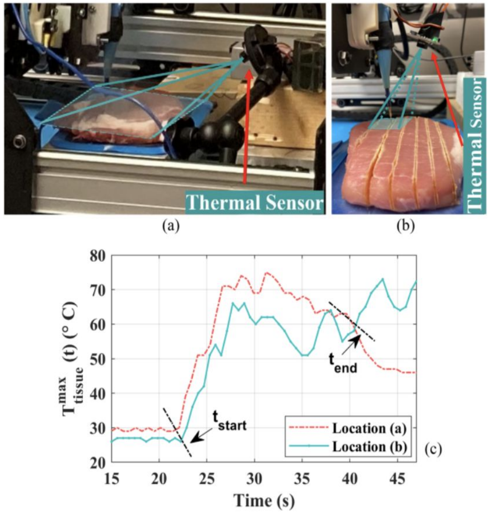
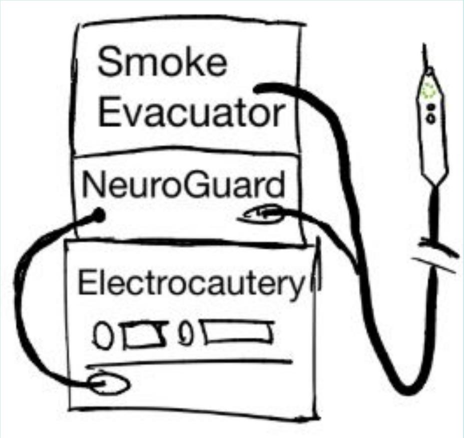


Fig. 2. Impact of thermal sensor mounting locations on temperature measurement. The thermal sensor used here is MLX90640 and its field of view during cutting is approximately illustrated as the teal shadow. (a) The sensor is mounted externally to the electrode. (b) The sensor is mounted together with the electrode. (c) The obtained maximum tissue surface temperature. t_{start} and t_{end} indicate the beginning and end of cutting, respectively.

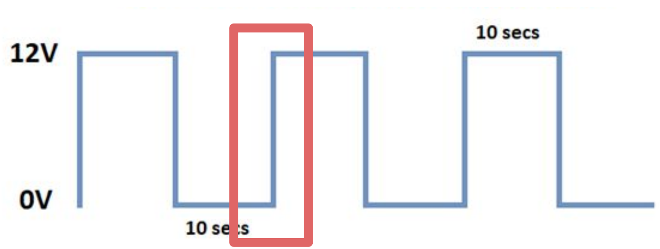
Return to FAQs

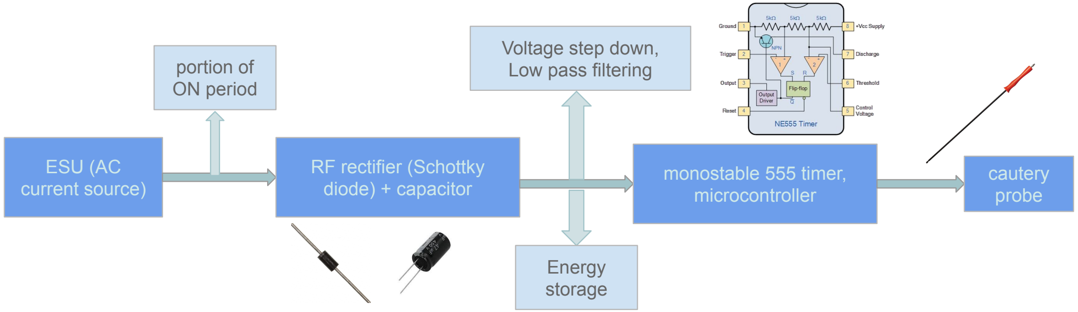
Integration with existing tools

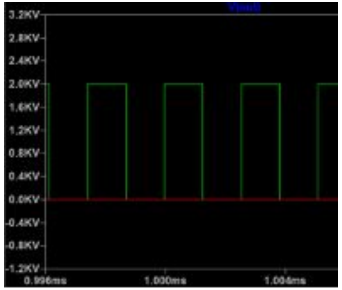
- We envision our device as an add on to electrocautery generator
  - Lower costs, more accessible, small learning curve
  - NeuroGuard probes which are compatible with Bovie and smoke evac systems

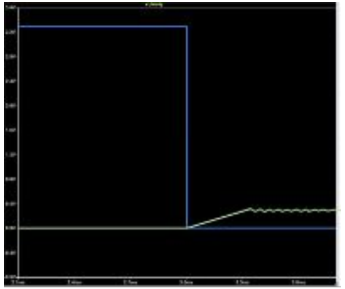


Prelim Circuit Design









Current iteration will be provided to participating senior design team

ECE 445, Fall 2025 Project

Deliverables

A. Simulation of circuit demonstrating ability to switch between predefined electrocautery and nerve stimulation waveforms at specified time intervals
   a. Dynamic impedance tracking → next step
B. Prototyped circuit from Part. A that can be integrated with an electrosurgical unit and standard cautery probe

Circuit Development

- Implement pulse width modulation schemes that alternate between cautery and nerve-specific stimulation waveforms, using a high voltage, high frequency ESU as the power source.
- Develop timing circuits to control nerve-specific stimulation pulses.
- Design safe, real-time modulation hardware compatible with existing ESUs.

Device Prototyping

- Design and test functional PCB layouts
- Integrate hardware with microcontrollers, or if interested, FPGA-based systems

Working with NeuroGuard for ECE 445

Opportunities to explore:

- Advanced circuit design and prototyping (power electronics)
- Medical devices
- Surgical/intraoperative considerations (patient safety, energy delivery, neurophysiology, etc.)

Forward-thinking Team:

- 1st place, 2024 CIMED Health Makeathon
- Finalists, 2025 Global Consortium Healthcare Innovation Challenge
- Semifinalists, 2025 Grainger Engineering Tech Challenge at Chicago Week
- Research and Innovation Pathway Grant, Carle Illinois College of Medicine

Real-World Impact: NeuroGuard has the potential to lower global nerve injury rates in mastectomies—especially in resource-limited settings where access to advanced equipment is limited. You'll work closely with medical students, surgeons, and engineering faculty, gaining exposure to translational innovation at the intersection of healthcare and engineering.

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